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Our Reference: SEA-147-D PATENT

VISCOUS MATERIAL DISPENSE SYSTEM

RELATED APPLICATIONS

[0001] This application is a divisional of prior application number 09/542,651 filed on April 4, 2000, Pat. No. 6,364,218, which was a continuation of prior application number 09/138,279 filed on August 21, 1998, now U.S. Patent No. 6,062,492 which was a continuation of provisional application number 60/085,642 filed on May 15, 1998.

BACKGROUND OF THE INVENTION

[0002] This invention relates to viscous material dispense systems and more particularly to a viscous material dispense system of the type utilizing a nozzle assembly to discharge a material bead in a controlled manner.

[0003] When designing a nozzle assembly for discharge of a material bead it is important to be able to precisely control the shape or "profile" of the bead as well as the movement aspect of the bead as it exits the nozzle. It has been proposed to direct a stream of air at the beaded material as it exits the nozzle assembly to attenuate and shape the bead, and, in fact, a multitude of nozzle assembly structures have been designed and utilized including means for directing a stream of air at the exiting bead. However, all of the prior art nozzle assembly air stream designs have either embodied a very complicated and expensive construction, and/or have not been effective to precisely shape the bead and/or have not been effective to impart the desired movement aspect to the bead as it exits the nozzle assembly.

SUMMARY OF THE INVENTION

[0004] This invention is directed to the provision of an improved viscous material dispense system.

[0005] More particularly this invention is directed to the provision of a viscous material dispense system employing a nozzle assembly having means to simply and effectively direct a stream of air against an exiting bead.

[0006] The viscous material dispense system of the invention comprises a material source having an outlet; a nozzle assembly including a tubular nozzle member having one end secured to the source outlet, another, free end defining a

nozzle tip portion having a conical nozzle surface, and an axially extending main body tubular portion interconnecting the one end and the nozzle tip portion; and a tubular air shroud including a main body portion positioned telescopically over the main body portion of the tubular nozzle member and a tip portion. The main body portion of the tubular air shroud coacts with the main body portion of the tubular nozzle member to define an annular axially extending air passage therebetween and an air inlet communicating with the passage, and the tip portion of the tubular air shroud is positioned proximate the tip portion of the nozzle member and defines a conical nozzle surface coacting with the conical nozzle surface of the nozzle member tip portion to define a conical air passage therebetween communicating with the annular axially extending air passage and opening in surrounding relation to the nozzle tip portion of the nozzle member. With this arrangement, air is introduced at the air inlet and flows as an annular curtain through the axially extending air passage and thereafter flows as a conical curtain through the conical air passage to impinge on a bead of viscous material exiting the nozzle assembly. This arrangement provides a simple and inexpensive means of precisely controlling the profile of the bead.

[0007] According to further feature of the invention, the annular axially extending air passage comprises a plurality of circumferentially spaced axially extending flutes, and the conical air passage comprises a plurality of circumferentially spaced radially extending flutes each communicating at one end thereof with a respective axially extending flute. With this arrangement the bead is not only attenuated and shaped by the air stream but the air stream further acts to impart a swirl or spiral movement aspect to the bead. An attenuated, spiraled bead provides a compact spiral pattern which is desirable in many bead application scenarios.

[0008] According to a further feature of the invention, the axially extending flutes are defined by axially extending grooves in an outer surface of the main body portion of the nozzle member and the radially extending flutes are defined by radially extending grooves in the conical surface of the tip portion of the nozzle member.

This arrangement provides a simple and effective means of providing the desired axial and radial flutes.

[0009] According to further feature of the invention, the air shroud is axially shorter than the nozzle member and fits as a cap over the conical tip portion of the nozzle member. This arrangement simplifies the structure of the air shroud and simplifies its positioning over the nozzle member.

[0010] According to further feature of the invention, the nozzle assembly further includes a mix tube having one end secured to the source outlet and another free end defining a conical nozzle tip portion, and the tubular nozzle member is positioned telescopically over the mix tube in shrouding relation with its nozzle tip portion proximate the conical nozzle tip portion of the mix tube. This arrangement allows the system to be readily utilized in dispensing a two part material mix.

[0011] According to further feature of the invention, the nozzle assembly further includes a tubular conical insert positioned in the mix tube proximate the nozzle tip portion thereof and operative to define the size and configuration of the bead. This arrangement allows the bead size to be readily modified simply by changing the conical insert.

[0012] According to further feature of the invention, the nozzle assembly further includes a tubular dispenser tip positioned in the conical tip portion of the nozzle member and defining a conical surface positioned centrally within the conical air passage and forming a radially inwardly extending extension of the conical air passage. This arrangement provides a smooth transition from the air passage defined between the nozzle member and the air shroud to the precise location of the exiting bead.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIGURE 1 is a view of a viscous material dispense system according to the invention;

[0014] FIGURE 2 is a view of the system of FIGURE 1 rotated through 90° and partially cross-sectioned;

[0015] FIGURE 3 is a bottom view of the system of FIGURES 1 and 2;

[0016] FIGURE 4 is a view corresponding to FIGURE 2 with different cross-sectioning;

[0017] FIGURE 5 is a detail view taken within the circle 5 of FIGURE 4;

[0018] FIGURE 6 is a cross-sectional view taken on line 6-6 of FIGURE 4;

[0019] FIGURE 7 is a detail view taken within the circle 7 of FIGURE 6;

[0020] FIGURE 8 is an enlarged cross-sectional view taken within the circle 8 of FIGURE 2; and

[0021] FIGURE 9 is an exploded view of the viscous material dispense system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] The viscous material dispense system of the invention is utilized to dispense a bead of viscous material from a nozzle assembly for application to a suitable surface. The invention is described with reference to the dispensing of a two component viscous material but aspects of the invention may also be applied to the dispensing of a single component viscous material. The materials may include epoxies, silicones, urethanes, acrylics, polyesters, or other viscous materials.

[0023] The viscous material dispense system includes a material valve 10 and a nozzle assembly 12.

[0024] Material valve 10 (Figs. 1,3,4) includes a main body portion 10a and a discharge or outlet 10b. A first synthetic resin material A is delivered via a hose 10c to one side face of the main body portion 10a and a second synthetic resin B is delivered by a hose 10d to an opposite side face of the main body portion 10a. It will be understood that in each case the resin emanates from a suitable large volume source and is provided to the hoses 10c and 10d in pressurized form. The resins A and B move separately through the main body portion of the material valve and separately through the discharge outlet 10b of the material valve, and the material valve includes, in known manner, an air actuated valve means to control the movement of the materials A and B through the material valve.

[0025] Nozzle assembly 12 includes a mix tube 14, an insert 16, a mixer shroud 18, a dispense tip 22, and an air shroud 20.

[0026] Mix tube 14 (Figs. 2,4,8,9) is formed of a suitable plastic material and includes a tube member 24 and a plurality of mix elements 26 and 28 comprising alternating left and right hand helical elements positioned in stacked fashion within tube member 24. The upper end of tube member 24 defines a large mouth mounting portion 24a and the lower end of the tube member defines a conical nozzle tip portion 24b which is stepped at 24c to allow the tube member to be selectably clipped at a selected step to selectedly vary the size of the discharge opening of the tube member. Mix tube 14 may comprise, for example, a tube assembly available from ConProTec, Inc. of Salem, New Hampshire under the tradename "STATOMIX"®.

[0027] Dispensing means, such as tip insert or nozzle insert, hereinafter referred to as insert 16 is formed of a suitable plastic material and is shaped and configured to fit within the lower end 24b of tube member 14 with a conical main body portion 16a of the insert positioned within a conical bore 24e defined within the lower end 24b of the tube member with an upper flange portion 16b of the insert seating on a shoulder 24d defined by the tube member at the intersection of the main body portion of the tube member and the lower end 24b of the tube member.

[0028] Mixer shroud 18 is in the form of a tubular nozzle member, is formed of a suitable plastic material and includes a large mouth upper end mounting portion 18a, a lower nozzle tip portion 18b defining a conical nozzle surface 18c, and an axially extending main body portion 18d interconnecting upper end portion 18a and nozzle tip portion 18b. A plurality of circumferentially spaced, axially extending flutes or grooves 18e are provided in the lower end section 18f of the main body portion 18d and a plurality of circumferentially spaced radially extending flute grooves 18g are provided in the conical surface 18c of the tip portion. There are a corresponding number of axial flutes and radial flutes and each radial flute communicates at the upper end thereof with the lower end of an axial flute so that the axial and radial flutes combine to provide a plurality of circumferentially spaced grooves extending down the outside of the lower portion of the mixer shroud and then extending radially inwardly along the conical surface 18c of the nozzle tip portion of the shroud.

[0029] Tubular air shroud 20 is formed of a suitable brass material and includes an annular main body portion 20a and a nozzle tip portion 20b forming a conical lower nozzle surface 20c. A pair of diametrically opposed air inlet apertures 20d are provided proximate the upper end 20e of the main body portion of the main body portion of the shroud. Air shroud 20 will be seen to be significantly shorter than mixer shroud 18.

[0030] Dispense tip 22 is formed of a suitable plastic material and includes a main body portion 22a sized to fit telescopically within an aperture 18h in the tip portion of the mixer shroud 18, an upper annular flange portion 22b sized to seat on an annular seat 18i defined at the lower end of the mixer shroud, and a lower conical tip portion 22c defining a conical surface 22d and a central discharge aperture 22e.

Sub a1 [0031] In the assembled relation of the various components of the viscous material dispense system, dispense tip 22 is positioned in the aperture 18h in the lower end of the mixer shroud 18 with flange portion 22b seated on shoulder 18i and with the conical lower surface 22d of the dispense tip positioned centrally within the conical lower surface 18c of the mixer shroud and forming a radially inwardly extending conical extension of the conical surface 18c; insert 16b is positioned in the lower nozzle tip end 24b of tube member 24 with flange 16b seating on annular shoulder 24c; the upper mouth end 24a of mix tube 14 is positioned over the lower conical portion 10e of material valve discharge outlet 10b; mixer shroud 18 is positioned telescopically over mix tube 14 with the upper mouth end 18a of the mixer shroud positioned over the upper portion 10f of the discharge outlet 10b of the material valve and with the lower end 24b of tube member 24 positioned in the main body portion 22a of the dispense tip and the lower end 16c of the insert 16 positioned proximate the mouth or discharge opening 22e of the dispense tip; and air shroud 20 is positioned telescopically over the lower end 18f of the main body portion 18d of the mixer shroud with conical surface 20c positioned proximate conical surface 18c and with air inlets 20d positioned proximate the upper ends of the grooves or flutes 18e. An annular elastomeric seal 29 is provided between the upper end 20e of the air shroud and the conforming annular surface of mixer shroud 18.

[0032] Shroud 20 will be seen to coact with the lower section of the main body portion of the mixer shroud to define a plurality of circumferentially spaced axially extending flutes or grooves, as defined by the flutes 18e and the confronting inner surface of the air shroud, and a plurality of circumferentially spaced radially inwardly extending flutes or grooves as defined by the flutes 18g and the confronting conical surface 20c of the air shroud. It will be seen that flutes 18g have an arcuate configuration in cross section and do not extend all the way radially inwardly to the central discharge aperture 18h of the mixer shroud. Conical lower surface 18c of the mixer shroud and the conical surface 20c of the air shroud diverge as they extend radially inwardly so that with the annular lower corner 18k of the mixer shroud positioned in the annular lower corner 20f of the air shroud, a conical passage 30 is defined between the radially inner portion 18j of conical surface 18c and the confronting portion of conical surface 20c. It will be seen that a continuous annular air passage is defined between air inlets 20d and the discharge opening 20g of the air shroud. Specifically, a plurality of axially extending and circumferentially spaced air passages extend down the outer periphery of the lower end of the mixer shroud and communicate respectively with a plurality of radially inwardly extending passages defined in the lower conical face of the mixer shroud, whereafter the individual air streams moving downwardly and then radially inwardly converge into an annular air passage 30 to arrive at the discharge opening 20g where the air continues to move radially inwardly along the conical surface 22d of the dispense tip until it arrives at the discharge opening 22e of the dispense tip.

[0033] In operation, synthetic resins A and B are supplied continuously by hoses 10c and 10d to the material valve where they flow individually through the valve and are discharged individually through discharge outlet portion 10c into the upper end of the tube member 24. The two-part resins flow downwardly through the tube member 24, engaging successive opposite helixes 26 and 28 and being successively folded over in a compounding manner so that they emerge at the upper end of insert 16 as a totally homogenous mix. The mixed material moves downwardly through the insert 16 and is discharged as a mixed material bead C at the central aperture 22e of the dispense tip. As the bead emerges from the aperture 22e it

is acted upon by the air streams moving downwardly through the flutes 18a, radially inwardly through the flutes 18g, further radially inwardly through the annular passage 30, and thence along the conical surface 22d. As the air streams impinge upon the emerging material bead C they act to impart a swirling movement to the bead so that the bead C is deposited as a compact spiral spray pattern along a surface adhesive path 32a on a part 32 in response to relative movement between the nozzle assembly and the part 32. Relative movement between the nozzle assembly and the part 32 may be achieved by movement of the part 32 past the nozzle assembly but more typically will be achieved by movement of the nozzle assembly by an associated robot programmed to move the nozzle assembly along the adhesive path 32a. It will be understood that air is delivered to air inlets 20d through suitable hoses connected with suitable sources of pressurized air. The air supply pressure may be varied during the course of the dispense cycle to compensate for changes in robot tool tip speed and/or changing height between the discharge orifice and the surface to which the swirled adhesive pattern is applied.

[0034] The airstream arrangement of the invention has been found to be capable of imparting a swirl pattern to the exiting bead without the need, as in prior devices, to direct individual air streams precisely tangentially to the exiting bead. Rather, it has found that the individual radially inwardly moving air streams have the effect of imparting the desired swirling movement to the bead without concern for precise impingement of the air streams on tangential surfaces of the bead.

[0035] It will be seen that the invention provides a viscous material dispense system that is simple and inexpensive in construction and that is readily adaptable to accommodate a wide variety of different materials and a wide variety of bead configurations.

[0036] Whereas a preferred embodiment of the invention has been illustrated and described in detail it will be apparent that various changes may be made in the disclosed embodiment without departing from the scope or spirit of the invention. For example, although the invention has been illustrated and described with respect to a two component synthetic resin system, it will be apparent that features of the invention may be readily applied to a single component system.